“Art of Café” Coffee Shop Network Design

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1. Scenario

"Art of Café" is a coffee and bakery shop for those who enjoy the coffee and relax in an aesthetic design shop. The infrastructure of the "Art of Café" network system includes the head office, employee office, cloud server and the coffee shop.

The head office has two departments: IT department, Administration department. The employee office has an HR department, Finance Department, Production Department, and Employee Department. At the Cloud server, there is a main file server which can only be accessed by the main office: IT department and Admin department. The coffee shop is constructed with two floors. First floor is for buying and ordering coffee and food. On the second floor, the customer can get the food and can pay the bill.

Part A- Designing a network

2. Topology (Hierarchical Network Design)

The coffee shop can increase its number of employees and numbers and it can grow to multiple branches in different locations. However, a network needs to support data traffic, such as email sending, data reporting, file serving, and web accessing. The users of the network system (administrators, IT technicians, managers, employees, staff, customers, etc.) may spread over many locations and can access at the same time simultaneously. Therefore, hierarchical design framework is the most suitable topology to create simplicity and easy to grow and track.

The advantages of using hierarchical network design:

1) **Scalability**: The coffee shop network can grow multiple branches with losing availability and reliability. So, new branches can be added, upgraded, and modified as necessary, without affecting the network accessing of the exciting shop and office.
2) **Modularity**: Changes are facilitated by hierarchical architecture. When designing a new network, modularity enables to produce design features that can duplicate as the network expands.
3) **Efficiency**: All switches used in network are high-performance switches in order for a full mesh network topology to operate at its peak efficiency since each switch must be able to handle every task on the network.
4) **Redundancy**: The availability of a network becomes increasingly critical as it grows. Simple redundant implementations of hierarchical networks can greatly boost availability.
5) **High Availability**: Redundant paths offer data to traverse the network supporting high availability. Adding to an existing hierarchical network is modular, so additions to network equipment scale linearly in cost.
6) **Security**: It is enhanced and more easily managed. Different port security settings that allow for control over which devices are permitted to connect to the network can be configured in access layer switches.

3. System Architecture

3.1 Devices used for the network

"Art of Café" Coffee Shop		
Main Office	IT Department	• 2960 Switch

		• PC • Email Server • Web Server
	Admin Department	• 2960 Switch • PC • Printer
Employee Office	HR Department	• 2960 Switch • PC • Printer
	Finance Department	• 2960 Switch • PC • Printer
	Production Department	• 2960 Switch • PC • Printer
	Employee Department	• 2960 Switch • PC • Printer
Coffee Shop	1st Floor Coffee Shop	• 2960 Switch • PC • Printer
	2nd Floor Coffee Shop	• 2960 Switch • PC • Printer
Cloud		• 2911 Router • File Server
2911 Main Router		
3650-24PS Layer 3 Switch		

3.2 System Specification

The main office, employee office and coffee shop can interconnect with each other. Nevertheless, the cloud file server can be only accessed by the main office. Therefore, Access Control Lists (ACL) is used to filter packets.

4. Network Design

4.1 Lab Design

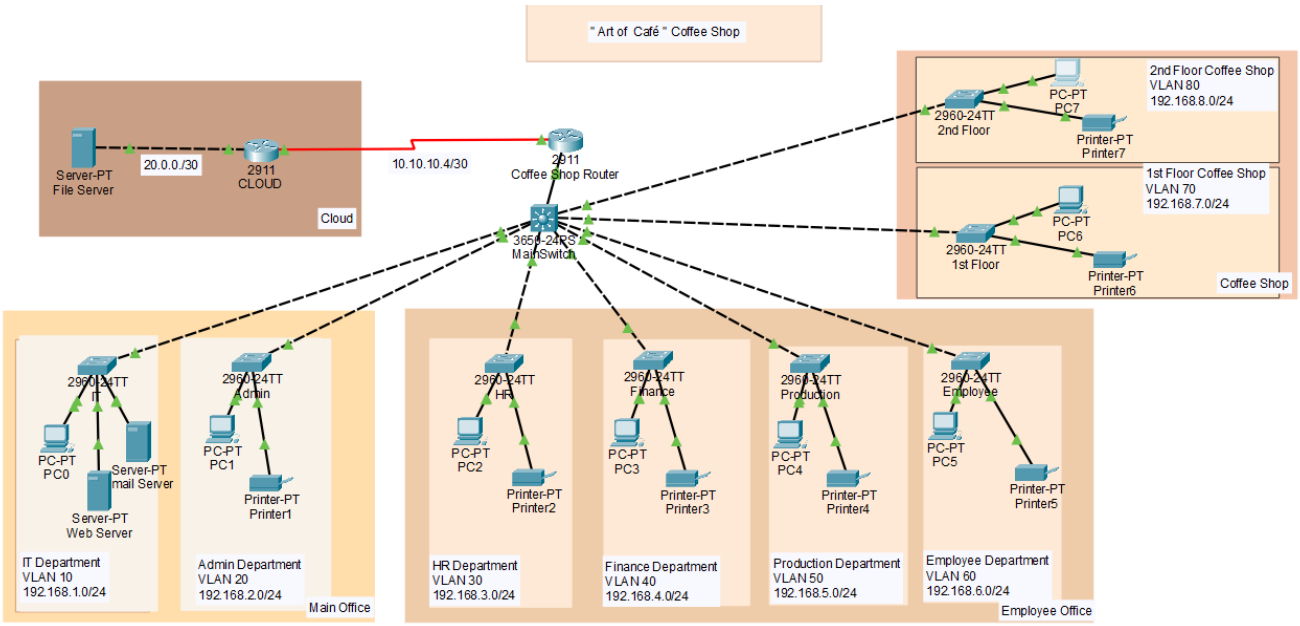

Figure 1: Lab Design

4.2 Addressing Table

Device	Interface	IP Address	Subnet Mask	Default Gateway
Coffee Shop Router	S0/1/0	10.10.10.5	255.255.255.252	N/A
	S0/1/1	10.10.10.9	255.255.255.252	N/A
Cloud Router	G0/0	20.0.0.1	255.255.255.252	N/A

	S0/1/0	10.10.10.6	255.255.255.252	N/A
File Server	NIC	20.0.0.2	255.255.255.252	20.0.0.1
Web Server	NIC	192.168.1.3	255.255.255.0	192.168.1.1
Email Server	NIC	192.168.1.4	255.255.255.0	192.168.1.1
PC0	NIC	192.168.1.2	255.255.255.0	192.168.1.1
PC1	NIC	192.168.2.2	255.255.255.0	192.168.2.1
PC2	NIC	192.168.3.2	255.255.255.0	192.168.3.1
PC3	NIC	192.168.4.2	255.255.255.0	192.168.4.1
PC4	NIC	192.168.5.2	255.255.255.0	192.168.5.1
PC5	NIC	192.168.6.2	255.255.255.0	192.168.6.1
PC6	NIC	192.168.7.2	255.255.255.0	192.168.7.1
PC7	NIC	192.168.8.2	255.255.255.0	192.168.8.1

Part B- Technologies used designing a network

5. Technologies used in the Network System

5.1 DHCP

To assign a unique IP Address on each device, DHCP helps to monitor and assign IP addresses in a centralized manner. DHCP automates the process of allocating IP addresses which reduce the time for device configurations, deployment and configuration errors. The implementation of subnetwork for each department and coffee shop used DHCP are as follow:

```
ip dhcp pool it-pool
 network 192.168.1.0 255.255.255.0
 default-router 192.168.1.1
 dns-server 192.168.1.1
ip dhcp pool admin-pool
 network 192.168.2.0 255.255.255.0
 default-router 192.168.2.1
 dns-server 192.168.2.1
ip dhcp pool hr-pool
 network 192.168.3.0 255.255.255.0
 default-router 192.168.3.1
 dns-server 192.168.3.1
ip dhcp pool finance-pool
 network 192.168.4.0 255.255.255.0
 default-router 192.168.4.1
 dns-server 192.168.4.1
ip dhcp pool production-pool
 network 192.168.5.0 255.255.255.0
 default-router 192.168.5.1
 dns-server 192.168.5.1
ip dhcp pool employee-pool
 network 192.168.6.0 255.255.255.0
 default-router 192.168.6.1
 dns-server 192.168.6.1
ip dhcp pool 1stfloor-pool
 network 192.168.7.0 255.255.255.0
 default-router 192.168.7.1
 dns-server 192.168.7.1
ip dhcp pool 2ndfloor-pool
 network 192.168.8.0 255.255.255.0
 default-router 192.168.8.1
 dns-server 192.168.8.1
```

Figure 2: DHCP Implementation

5.2 VLAN

This technology can logically partition one or more LAN networks into multiple domains. Only devices under the same VLAN can communicate with each other automatically. It improves network flexibility and performance. The coffee shop network system is divided into VLAN 10, 20, 30, 40, 50, 60, 70 and 80 according to the separated floors and buildings.

```
VLAN Name                              Status    Ports
---- --------------------------------- --------- -------------------------------
1    default                           active    Gig1/0/10, Gig1/0/11, Gig1/0/12, Gig1/0/13
                                                 Gig1/0/14, Gig1/0/15, Gig1/0/16, Gig1/0/17
                                                 Gig1/0/18, Gig1/0/19, Gig1/0/20, Gig1/0/21
                                                 Gig1/0/22, Gig1/0/23, Gig1/0/24, Gig1/1/1
                                                 Gig1/1/2, Gig1/1/3, Gig1/1/4
10   VLAN0010                          active    Gig1/0/2
20   VLAN0020                          active    Gig1/0/3
30   VLAN0030                          active    Gig1/0/4
40   VLAN0040                          active    Gig1/0/5
50   VLAN0050                          active    Gig1/0/6
60   VLAN0060                          active    Gig1/0/7
70   VLAN0070                          active    Gig1/0/8
80   VLAN0080                          active    Gig1/0/9
1002 fddi-default                      active
1003 token-ring-default                active
1004 fddinet-default                   active
1005 trnet-default                     active
```

Figure 3: Vlan Implementation

5.3 Access and Trunk Interface

In the Interface G1/0/1, use switchport mode trunk to configure as trunk. For other defined interfaces of Layer 3 switch, access mode is used to assign the ports or range of ports into access points.

```
interface GigabitEthernet1/0/1
 switchport mode trunk
!
interface GigabitEthernet1/0/2
 switchport access vlan 10
 switchport mode access
!
interface GigabitEthernet1/0/3
 switchport access vlan 20
 switchport mode access
!
interface GigabitEthernet1/0/4
 switchport access vlan 30
 switchport mode access
!
interface GigabitEthernet1/0/5
 switchport access vlan 40
 switchport mode access
!
interface GigabitEthernet1/0/6
 switchport access vlan 50
 switchport mode access
!
interface GigabitEthernet1/0/7
 switchport access vlan 60
 switchport mode access
!
interface GigabitEthernet1/0/8
 switchport access vlan 70
 switchport mode access
!
interface GigabitEthernet1/0/9
 switchport access vlan 80
 switchport mode access
!
```

Figure 4: Access and Trunk Interface Implementation

5.4 OSPF

The network used OSPF routing because OSPF has better convergence than RIP. OSPF allows for better load balancing. The Coffee Shop Router and Cloud Router establish and maintain neighbor adjacencies with their OSPF link-state database.

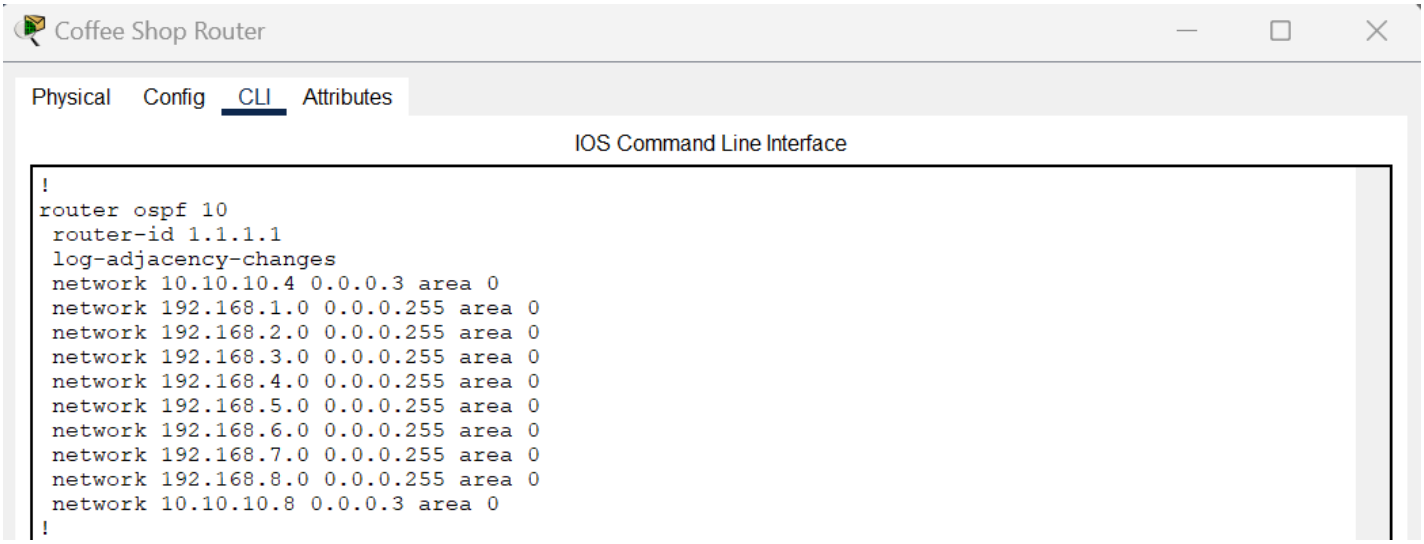

Figure 5: OSPF Implementation on Coffee Shop Router

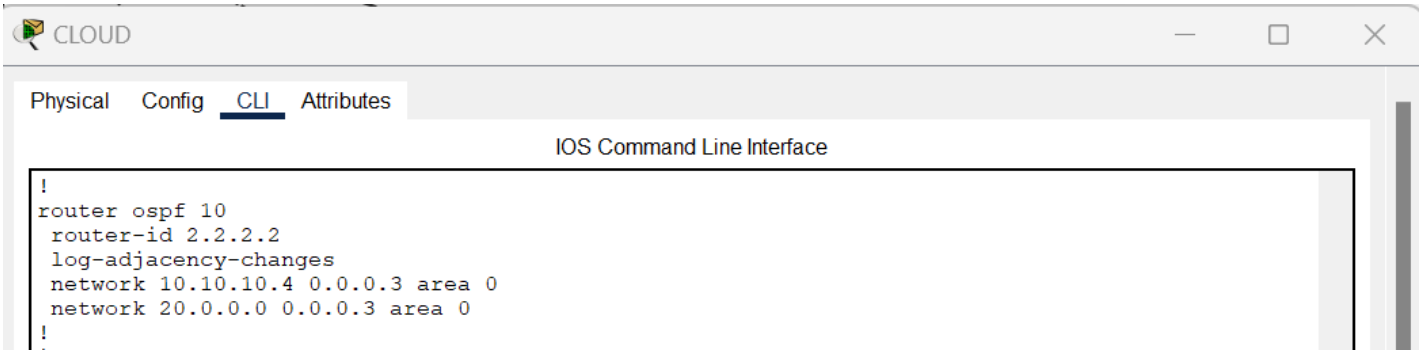

Figure 6: OSPF Implementation on Cloud Router

5.5 ACl

The Cloud File Server can be only accessed by the main office departments of the IT department and Admin department. The other departments and coffee shops cannot access the File Server but can access Web Server and Email Server. Therefore, the network must implement packet filtering ACL by analyzing the incoming and outgoing packets and decide to forward them or discard them. At the Interface S0/1/0 of the Coffee Shop Router, a standard named ACL **FILEACCESS** is created.

```
!
ip access-list standard FILEACCESS
 permit 192.168.1.0 0.0.0.255
 permit 192.168.2.0 0.0.0.255
 deny any
!

!
interface Serial0/1/0
 ip address 10.10.10.5 255.255.255.252
 ip access-group FILEACCESS out
 clock rate 64000
!
```

Figure 7: ACL Implementation

5.6 Secure Device Access

The network security is the most important aspect for the implementation of the design. An authorized person should not gain administrative access to the router. Therefore, log and account action, and authenticate accessing must be protected. Password-encryption service is more useful than plaintext password. SSH configured in a router can be used to access the privilege and configuration mode of a Router and a Switch from a remote location to perform the required action.

```
!
line vty 0 4
 login local
 transport input ssh
```

Figure 8: Secure Device Access Implementation

```
CoffeeShop>en
Password:
00:00:10: %OSPF-5-ADJCHG: Process 10, Nbr 2.2.2.2 on Serial0/1/0 from LOADING to FULL, Loading
Done

Password:
CoffeeShop#
```

Figure 9: Password Require

Part C- Investigation of Network Traffic

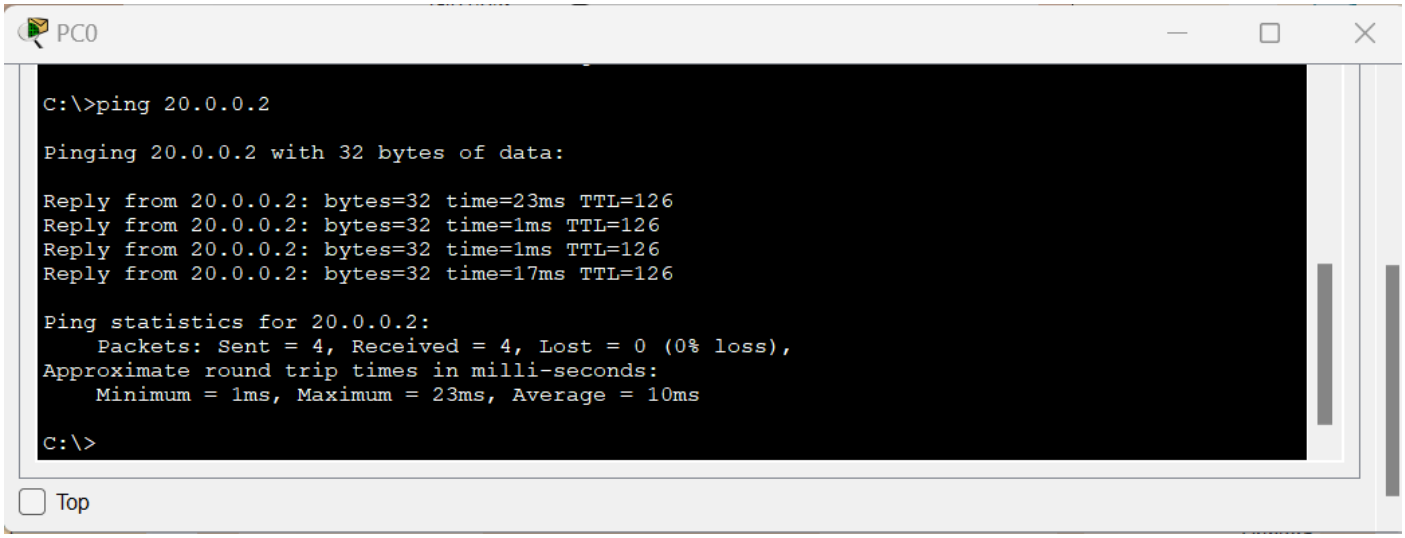

Figure 10: IT department of Main office ping File Server (Successful)

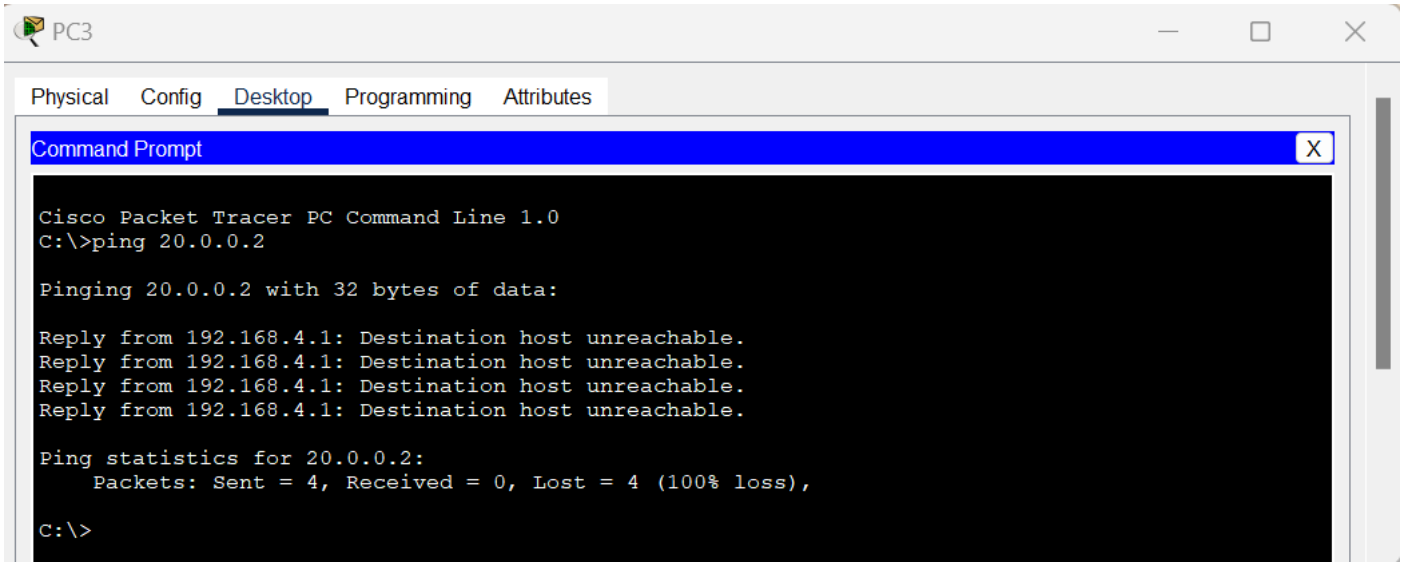

Figure 11: Finance Department of Employee Office ping File Server (Unreachable)

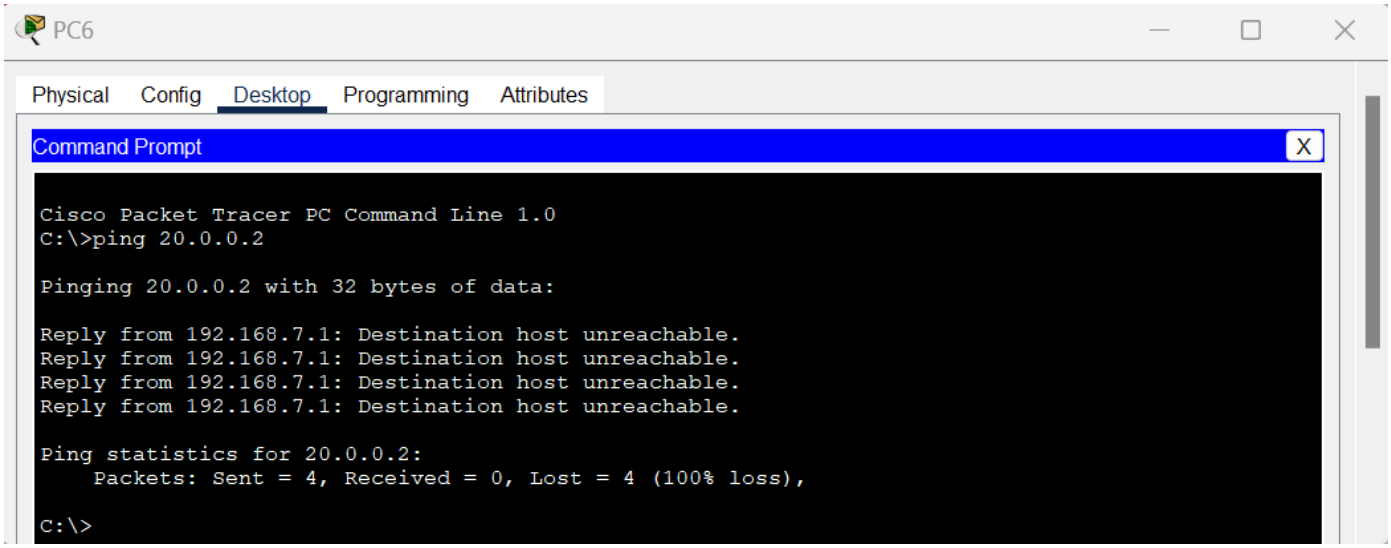

Figure 12: 1st Floor of Coffee Shop ping File Server (Unreachable)

6. Conclusion

The “Art of Café” Coffee Shop network design configures a hierarchical design framework to support converged network traffic and provide centralized administrative control. Since the shop system has the configuration of multiple network segments, DHCP is used to provide efficient change management and reduce IP address conflict. The infrastructure of the network is divided by multiple VLAN. It can improve security and performance by isolating traffic on the network. The network system uses single-area OSPF network topology; each router maintains a database that describes the topology of the AS. Access Control List (ACL) provides the ability to control the traffic in the network. ACL set up in the main router according to requirements in the network. SSH service creates as a secure requirement and provides for authenticating a remote user, transferring from client to host, and relaying the output back to the client. Therefore, The “Art of Café” Network system uses the above technologies and strategies to implement the network scalability, modularity, efficiency, redundancy, high availability, and security.

7. References

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